أكاديمية
أنــور قـرقـاش
الدبلوماسية
ANWAR GARGASH DIPLOMATIC ACADEMY

Centre for Climate Diplomacy

How Technology is Reshaping Disaster Response in the Era of Climate Change?

Joe Y Battikh

November 2025

About the Author

Joe Y Battikh

is a Non-resident Research Fellow at the Centre for Climate Diplomacy, Anwar Gargash Diplomatic Academy. Joe's research agenda focuses on the pivotal role of the private sector in addressing climate security threats, with a special focus on disaster response in developing countries. His experience spans the private sector and international humanitarian organisations. Notably, he headed the Energy & Water Knowledge Hub for the International Committee of the Red Cross in the UAE and led Sustainability, Corporate Responsibility, and Government & Industry Relations for Ericsson across the Middle East and East Africa. This diverse background enriches his current pursuit of a PhD in sustainability management at the University of Waterloo, Canada.

Summary

- Climate-related natural disasters are increasing in frequency and severity, disproportionately affecting developing countries with limited infrastructure, economic constraints, and political fragility. This paper explores how technology, like telecommunications, AI, GIS, satellite imagery, and early warning systems, can improve preparedness, coordination, and response during these crises.
- The paper highlights the concept of technological humanitarianism, emphasizing how Information and Communication Technology (ICT) companies, in partnership with governments and NGOs, are reshaping disaster management. These collaborations bring advanced tools, technical expertise, and scalable infrastructure to fragile settings where local capacity is often overwhelmed.
- Case studies from Kenya and Libya demonstrate the operational value of integrated technology. In Kenya, tools like drone images, SMS alerts, and AI-analysed satellite imagery supported rapid response during severe flooding. In Libya, AI-assisted damage assessment and remote sensing enabled faster, more accurate decision-making after catastrophic floods.
- The UAE is presented as an emerging model for technology-driven disaster response, leveraging Earth Observation satellites and AI research institutions to contribute globally to climate resilience. National institutions such as MBZUAI and the UAE Space Agency are actively partnering with global platforms to assess loss and damage in disaster zones.
- Despite progress, the paper outlines several key challenges: digital exclusion limits access to life-saving tools; infrastructure failures disrupt communications; fragmented data systems reduce efficiency; and the absence of ethical safeguards around AI and data use raises concerns about equity and accountability.
- The paper concludes that meaningful progress in disaster response will require investment in resilient infrastructure, expanded access to advanced technologies, stronger local capacity, and policies that ensure ethical, inclusive technology deployment. Without addressing these systemic gaps, innovation alone will not reduce disaster vulnerability in high-risk regions.

Introduction

The growing frequency and severity of natural disasters due to climate change pose significant challenges for global disaster management particularly in developing countries. From hurricanes and floods to wildfires and droughts, these events have become more frequent and intense, disrupting lives, infrastructure, and economies. As the impacts of climate change continue to escalate, there is a pressing need for innovative solutions to enhance disaster preparedness, response, and recovery efforts. In this context, technology has emerged as a critical tool for mitigating the impacts of natural disasters and strengthening resilience in vulnerable communities.

Technological advancements, such as telecommunication infrastructure, early warning systems, satellite imagery, geographic information systems (GIS), and artificial intelligence (AI), are transforming the field of disaster management. These tools enable rapid assessment, real-time monitoring, and effective resource allocation during crises, allowing response teams to make data-driven decisions. For example, early warning systems leverage predictive analytics and real-time data to provide communities with critical information about impending disasters, enabling timely evacuations and risk mitigation. Similarly, satellite imagery and GIS offer a comprehensive view of disaster-affected areas, enabling accurate damage assessment and informed resource allocation. AI enhances these capabilities further by analysing large datasets to predict disaster patterns, optimize logistics, and assess vulnerabilities.

In addition to the advancements in technology, the private sector—particularly within the Information and Communication Technology (ICT) industry—has demonstrated significant potential to contribute to disaster response efforts. Companies such as telecommunications providers, technology firms, and data analytics organizations possess resources, expertise, and infrastructure that can play a critical role in mitigating disaster impacts.[1] For instance, ICT companies can provide emergency communication networks, support data-driven decision-making, and deploy tools for real-time monitoring and resource management. These contributions are particularly vital in contexts where local capacity and resources are insufficient and/or overwhelmed.

In response to the pressing need to enhance disaster management efforts, a form of technological humanitarianism has gradually emerged, driven among other by the involvement of private sector companies. This represents the use of advanced technologies and digital tools to enhance humanitarian aid and disaster response efforts. This paper explores the critical role of technological humanitarianism and private sector engagement in responding to natural disasters, focusing on the synergies between technology tools, such as telecom infrastructure, early warning systems, satellite imagery, GIS, and AI. It examines how these tools, when combined with strategic partnerships, can address the growing challenges posed by climate change-induced disasters. Additionally, the study highlights case studies and best practices that demonstrate the transformative potential of such collaborations.

Natural Disasters Impact on Developing Countries

Natural disasters are extreme, sudden events caused by environmental factors that result in significant damage and disruption. They can manifest in various forms, including meteorological phenomena such as hurricanes and cyclones, geological events like earthquakes and landslides, and hydrological occurrences such as droughts and floods.[2] Each type of disaster has unique characteristics and impacts, but they are increasingly influenced by our changing climate conditions. According to the Intergovernmental Panel on Climate Change (IPCC),[3] human activities, are driving global warming, which in turn affects weather patterns and increases the likelihood of extreme weather events. As the climate continues to warm, the capacity of the atmosphere to hold moisture increases, leading to more intense rainfall and severe storms.

Natural disasters impact all countries but developing countries are disproportionately impacted compared to developed nations. According to the United Nations Office for Disaster Risk Reduction (UNDRR),[4] between 2000 and 2019, 83% of people affected by natural disasters lived in developing countries. This vulnerability is attributed to several factors. First, developing nations frequently struggle with insufficient funds and inadequate infrastructure to effectively manage disasters before, during, and after they occur. With limited investment5 in disaster preparedness, inadequate infrastructure, and economies heavily reliant on agriculture, developing countries are particularly susceptible to climate-induced disasters such as droughts, floods, and extreme weather events.[3,6]
Second, the interaction between climate change and socioeconomic conditions worsens the problem. Developing nations often face widespread poverty, insufficient infrastructure, and limited educational and healthcare opportunities.

These circumstances increase their susceptibility to natural disasters, as communities struggle to adapt to changing environment or bounce back from catastrophic events. Finally, the impact of natural disasters on political stability is a crucial consideration. Recurring catastrophes can exert pressure on societies, potentially increasing political volatility and risk, especially in nations with already fragile governance systems.[7,8]

Natural disasters cause greater loss of life and economic damage in developing countries in comparison to developed nations. This vulnerability stems from factors such as poverty, poor infrastructure, and weak governance. Addressing natural disasters is crucial for economic development and poverty reduction, particularly in developing countries. Breaking this cycle requires better disaster management strategies and solutions.

Technologies in Disaster Relief

Information and Communication Technologies have become increasingly crucial in disaster response and management. ICTs, such as telecommunication infrastructure, early warning systems, satellite imagery, and GIS are being utilized to predict, respond to, and recover from natural disasters more effectively. GIS and crowdsourced geographic information play crucial roles in disaster response and recovery efforts. Moreover, AI and machine learning are emerging as powerful tools for disaster forecasting, preparation, and response. While these technologies offer significant potential for improving disaster management, challenges such as data quality, interoperability, and implementation costs need to be addressed. Integrating these technologies is particularly vital for economically disadvantaged communities, which are more susceptible to natural calamities. Such actions could potentially yield the most significant benefits in these areas. The following sections highlight technological humanitarianism in practice.

Infrastructure

Telecommunications infrastructure is critical for maintaining communication channels during disasters, enabling effective coordination of emergency response efforts.[9,10] The collapse or congestion of these networks can severely hinder rescue operations and information dissemination.[11] Recent natural disasters have exposed vulnerabilities in existing systems, emphasizing the need for resilient and sustainable communication infrastructures.[9,10,11] Key strategies for improving disaster resilience include pre-disaster planning, real-time communication technologies, and post-disaster management.[12] Power supply issues are a major cause of telecom outages during disasters, highlighting the importance of robust backup systems.[14] Well-designed communications infrastructure contributes to community resilience and facilitates coordinated disaster response.[15]

Some ICT infrastructure companies have dedicated departments and teams for disaster response. For example, Ericsson, a multinational that provides telecommunication infrastructure, has Ericsson Response team[16], which is a stand-by partner to the United Nations World Food Programme[17] (WFP) and a partner of the Emergency Telecommunications Cluster[18] (ETC), a global network of organizations led by the WFP that provides communications in disaster situations.

When the Ericsson Response volunteers arrive in a disaster zone, their role is to enable temporary voice and data connectivity so that humanitarian relief agencies can quickly coordinate their relief efforts. Ericsson Response works together with relief agencies, governments and local authorities to prioritise deployments in affected areas, using its telecoms skills and technology to bring together the aid organizations that help alleviate the affected populations. The company's volunteers remain in the affected areas enhancing and maintaining networks and equipment until local services have sufficiently recovered or until the temporary network capacity is no longer needed.

Early warning systems

ICT can play a crucial role in disaster response and management by enhancing situational awareness and facilitating rapid information sharing. ICTs enable real-time communication, data collection, and decision support during crises.[19,20] Mobile applications, social media platforms, and other technologies allow for timely dissemination of critical information to the public and responders.[21,22] These tools also empower citizens to contribute valuable on-the-ground information.[19,23] The integration of ICTs in disaster management can improve interagency cooperation, community engagement, and overall response efficiency.[24,25] However, challenges remain, such as ensuring reliable communications and interoperable systems. As ICTs continue to evolve, they offer significant potential for enhancing disaster resilience and supporting various phases of disaster risk management, particularly in developing countries.[22,26]

Several early warning systems are developed by ICT companies that could be beneficiary in disaster response. For example, Google's AI-powered flood forecasting system.[27] This system combines two models: a Hydrologic Model and an Inundation Model. The Hydrologic Model processes publicly available data, such as precipitation, weather, and basin data, to forecast the amount of water flowing in a river.

The Inundation Model simulates water movement across the floodplain using the hydrology forecast and satellite imagery, predicting which areas will be affected and how high the water level will be. This combination allows the system to provide more accurate forecasts, and can evaluate whether a river's water level will rise or fall, and by how much, up to 7 days in advance.[28]

This flood forecasting system was used in Kenya during the 2024 historical devastating floods, to track forecasted river discharge in five areas designated by the Kenyan government as priority locations.[29] Google has also developed the Flood Hub[30], a publicly available visual tool that provides users with locally relevant flood data and forecasts, and provides alerts based on the AI models and global data sources. This tool could be useful to governments, aid organizations, and people directly at risk, and publish alerts on different platforms such as Google Search and Android notifications, to help more people access flood information.

Satellite imagery, Mapping & GIS

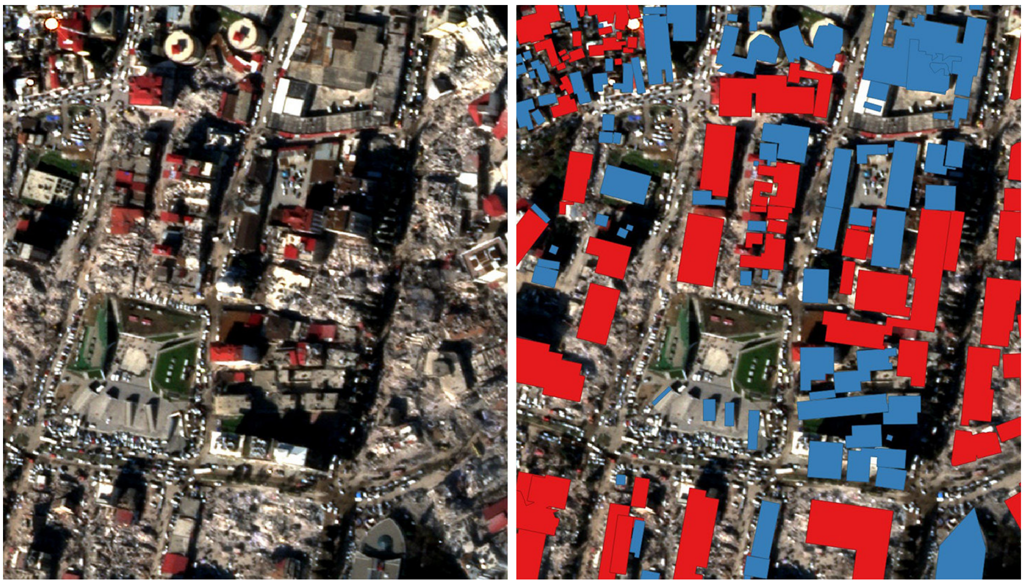
Satellite imagery, mapping, and geographic information systems (GIS) have become indispensable tools in modern natural disaster response, significantly enhancing decision-making and resource allocation. By providing real-time data and comprehensive situational awareness, these technologies enable more effective disaster management strategies and outcomes.

Satellite imagery offers an unparalleled vantage point for quickly assessing the extent of damage in disaster-affected areas. This technology facilitates the immediate identification of disaster zones, accurate mapping of impacted infrastructure, and real-time monitoring of events such as wildfires, floods, and hurricane damage. By delivering actionable insights promptly, satellite imagery allows emergency response teams to prioritize interventions and allocate resources where they are most needed.

GIS technology plays a critical role in developing and implementing emergency response plans. By integrating data on evacuation routes, shelters, and supply distribution hubs, GIS supports the creation of comprehensive crisis management strategies. Simulations of potential disaster scenarios, facilitated by GIS, enable robust planning and preparation for diverse contingencies. Additionally, GIS systems dynamically update in real-time, allowing for adaptive decision-making in rapidly evolving disaster scenarios.
Effective resource management is a cornerstone of disaster response, and GIS combined with satellite imagery significantly enhances this capability. These technologies assist in mapping the locations of vital assets, such as hospitals and emergency services, and facilitate inventory monitoring and efficient resource distribution. Moreover, they enable seamless data exchange and coordination among multiple emergency response agencies, ensuring a unified and effective response to crises. When these technologies are combined, they are especially useful in risk assessment and preparedness and damage assessment and recovery.

Risk Assessment and Preparedness: Beyond immediate disaster response, satellite imagery and GIS contribute significantly to long-term risk assessment and disaster preparedness. By identifying areas prone to specific hazards, these technologies enable the development of targeted vulnerability assessments and management plans. Risk zone maps, created through GIS, serve as essential tools for planning and preparedness, helping communities mitigate future risks and enhance resilience.

Figure 1: After the earthquake in Turkey on February 6th, 2023, the AI for Good Lab utilized AI methods and high-resolution satellite imagery to assess the extent of damage to buildings in the affected region. (Source: Microsoft[31])



Damage Assessment and Recovery: In the aftermath of a disaster, satellite imagery and GIS technologies are pivotal for assessing damage and guiding recovery efforts. The comparison of pre- and post-disaster imagery provides rapid and accurate evaluations of the severity and scope of damage, enabling the prioritization of rescue and recovery operations. Over time, these tools allow for monitoring recovery progress, ensuring that resources are deployed effectively to restore normalcy in affected areas.

Esri, a GIS technology company, has a Disaster Response Program that assists organizations responding to disasters or crises worldwide as part of their corporate citizenship.[32] The multinational supports response efforts with GIS technology and disaster response expertise. Esri can provide data, software, configurable applications, and technical support for the emergency GIS operations. This would ensure relief organizations to get to understand the situation, make better decisions, and respond more effectively during a crisis. By leveraging satellite imagery, mapping, and GIS, emergency response teams gain the ability to make informed, data-driven decisions, ensuring efficient resource allocation and coordination during natural disasters. These technologies not only enhance immediate response efforts but also contribute to building sustainable disaster preparedness frameworks, ultimately saving lives and reducing the socioeconomic impact of such events.

Case study 1: Cyclone Hidaya, Kenya (2024)

In 2024, Kenya experienced severe flooding as a result of above-normal rainfall during the March-April-May period. This unprecedented flooding was further intensified by landslides and mudslides, affecting 43 out of the country's 47 counties, making it one of the most devastating natural disasters in Kenya's recent history. This event resulted in significant human and agricultural impacts, with approximately 100,228 households affected, 54,205 individuals displaced, and 294 fatalities reported.[33] Over 65,000 acres of crops were damaged, threatening food security across various regions, including the Coastal areas, Central regions (including Nairobi), the Western Highlands, the Rift Valley, the Lake Victoria Basin, the South-eastern lowlands, and the North-eastern regions. The widespread geographic scope and the severe toll on human life and agriculture make this one of the most devastating flooding events in Kenya's recent history.

Technologies Used

The Kenya Red Cross Society (KRCS), in collaboration with the International Centre for Humanitarian Affairs (ICHA), and other NGOs such as the Kenya Uncrewed Air Systems Association, Help.NGO, and the Internet Society, employed various technologies to enhance their disaster response and recovery efforts during the recent floods. Some of these mixed technologies were satellite imagery and machine learning for rapid assessment of flood damage, drones for search and rescue operations, early warning systems to alert communities to potential hazards, and digital platforms for information dissemination and coordination.

- **Satellite Imagery and Machine Learning:** satellite imagery was used, including open-source data from Sentinel 1 & 2 satellites and high-resolution images from the Pleiades satellite, to conduct rapid assessments of flood-affected areas. This technology allowed to evaluate flood impacts on infrastructure, identify the most severely affected regions, and ensure efficient aid delivery. Machine learning analytics were used to determine flood extents by distinguishing flooded from non-flooded areas in the satellite images.
- **Drones:** Drones were deployed for various purposes, including search and rescue operations, mapping affected areas, and assessing hazardous areas. Drones were particularly useful in the Mai Mahui flash flood/mudslide incident, where they helped locate victims, assess damage, and evaluate hazards. Drones provided high-resolution imagery, enabling responders to identify locations where bodies had been carried, pinpoint areas where debris had accumulated, and assess the threat level of hazardous areas.

- **Short Message Service (SMS) Alerts:** With support from the telecommunication operator Safaricom, over 70 million early warning messages to 38 counties at risk of flooding were sent using the TERA SMS system. The Trilogy Emergency Rapid Response Alerts (TERA) system is a geo-located SMS messages designed to target areas most vulnerable to specific hazards. These messages, based on climate forecast information from the Kenya Meteorological Department, provided timely information on anticipated floods and recommended safety measures in English and Swahili.

The deployment of these technologies was possible thanks to the collaboration with ICT companies like AWS, ESRI, IBM, Microsoft, and META that integrated advanced technologies into KRCS operations. Moreover, these partnerships provided access to cloud-based solutions for data storage and management, geographic information system (GIS) technology for geospatial analysis, and expertise in data analysis and platform development. The growing reliance on these technologies underscores the importance of collaboration with technology companies and other humanitarian organizations, as well as the need for adaptability in responding to rapidly changing situations.[33]

AI in Disaster Response

AI is increasingly vital in disaster management, offering enhanced capabilities across all phases: mitigation, preparedness, response, and recovery. AI techniques, including machine learning and deep learning, can analyse diverse data sources such as satellite imagery, social media, and sensor networks to improve disaster prediction, detection, and response. AI applications in disaster management include damage assessment, resource allocation, and risk area identification. The integration of AI with GIS and remote sensing enhances situational awareness and decision-making capabilities for governments and relief agencies. However, challenges remain, including data reliability, algorithmic biases, and ethical concerns.[34]

Several AI based solutions are made available by ICT companies. For example, Microsoft's AI for Good Lab[35] developed an AI model to predict the impact of multiple hazards like cyclones in any given area in India.[36] By combining geospatial data, such as high-resolution satellite imagery, with innovative machine learning techniques where houses roofs were classified under seven categories, depending on the material used to construct them, the AI model can identify houses with roofs that can't withstand cyclonic wind speeds. This can help governments and relief agencies prioritize their response to those vulnerable households.

Another example is the use of AI to assess damages and improve disasters response after a natural disaster.37 Esri, applied different deep learning models to its GIS platform solution. By processing large number of aerial imagery, and applying advanced routing algorithms, the system can detect damaged structures, detect obstructed roads, and construct a response route in a timely manner to the first responders.

Figure 2: Hurricane Michael made landfall in October 2018, Esri's AI model was able to identify the locations of the damaged structures and blocked roads, and provided a response route to first responders (Source: Esri[37])

Case study 2: Storm Daniel floods in Libya (2023)

In September 2023, Storm Daniel caused catastrophic flash floods in Libya, particularly affecting the northeastern coastal areas. The storm brought high winds and extreme rainfall, with some areas receiving close to their annual average rainfall in a 25-hour period. The most severely affected areas included the city of Derna, where the collapse of two dams upstream triggered a deadly flash flood. The flooding resulted in widespread destruction of infrastructure, including buildings, roads, and bridges, and also caused significant loss of life.

Technologies Used

- **Satellite Imagery:** High-resolution pre- and post-disaster satellite images were crucial for assessing the extent of the damage. Various types of satellite imagery were utilized:
  - **Optical Imagery**: Multispectral images from Sentinel-2 were used to visually assess the damage. However, cloud cover posed a challenge for optical imagery.
  - **SAR (Synthetic Aperture Radar):** Sentinel-1A C-band SAR images were used to characterize flash flood erosion and sediment dynamics. SAR's ability to penetrate clouds made it useful when optical images were obscured.
- **AI-Assisted Damage Assessment:** A solution developed by the United Nations Global Pulse-led Data Insights for Social and Humanitarian Action (DISHA) coalition, in partnership with the United Nations Satellite Center (UNOSAT) and Google Research, used AI to assist human experts with damage assessments. The AI solution uses three models:
  - **Open Buildings:** A pre-trained vision model that detects and segments building structures in high-resolution satellite images.
  - **SKAI Zero-Shot:** A pre-trained vision model that identifies damaged buildings in satellite images, generating heatmaps to highlight areas needing priority.
  - **SKAI Fine-Tuned:** A supervised model that classifies building damage after being fine-tuned with images from the specific disaster and analyst-provided labels.

The use of these technologies, particularly AI-assisted damage assessment, significantly enhanced the ability of humanitarian organizations to respond to the disaster. For example, the AI solution has been shown to expand the area of analysis by a factor of 7 and reduce the time to produce directional findings by a factor of 6. These advancements allow for more efficient and comprehensive assessments of damage, helping to guide relief efforts.[34,35,36]

Private Sector and Disaster Response

The role of the private sector in disaster response is increasingly recognized as essential, particularly in the context of climate change, which is expected to exacerbate the frequency and intensity of natural disasters. The private sector's involvement extends beyond mere financial contributions; it encompasses a range of activities that leverage business capabilities, foster public-private partnerships, and enhance community resilience. Furthermore, the private sector's role in disaster relief has evolved from traditional philanthropic efforts to more strategic involvement that utilizes core business competencies. This shift towards a more integrated approach underscores the importance of businesses not only as aid providers but also as essential components of the disaster response infrastructure.

Public-private partnerships (PPPs) are another vital mechanism through which the private sector can enhance disaster management efforts. Effective collaboration between public entities and private organizations can lead to improved resource allocation, innovation in response strategies, and enhanced community engagement.[41,42] The establishment of such partnerships is particularly critical in developing countries, where governmental capacity and resources may be limited. By leveraging the strengths of both sectors, these collaborations can foster more resilient communities capable of withstanding the impacts of climate change-induced disasters.[43]

Furthermore, the private sector's involvement in disaster response is increasingly recognized as a corporate social responsibility (CSR) imperative. Companies are now increasingly aware of their ethical obligations to contribute to community welfare, especially in the face of climate change challenges.[44] This recognition has led to a surge in corporate initiatives aimed at disaster preparedness and response, with businesses actively engaging in relief efforts and supporting local communities during crises.[45]

The growing emphasis on CSR not only enhances a company's reputation but also contributes to building a more resilient society. In conclusion, the private sector plays a multifaceted role in disaster response, characterized by proactive planning, strategic partnerships, and a commitment to corporate social responsibility. As the impacts of climate change intensify, the need for businesses to engage in disaster management will become increasingly critical. By harnessing their resources, expertise, and innovative capabilities, private organizations can significantly enhance the effectiveness of disaster response efforts and contribute to the resilience of communities worldwide.

Technological Humanitarianism in the UAE

The United Arab Emirates (UAE) employs advanced technologies, particularly Earth Observation (EO) and AI, to enhance disaster response, addressing climate change-induced natural disasters while supporting its commitments to climate action and humanitarian efforts. EO, a process of collecting information about the Earth's surface, atmosphere, and waters, using orbiting satellites, is central to these efforts. The UAE contributes to the development of EO through several initiatives, such as the International Charter, an integrated global system to manage disaster mitigation, relief, and prevention efforts through international cooperation. For example, the UAE Space Agency has contributed analytical reports and satellite data to support international relief efforts during the earthquake crisis in Morocco in 2023.[46] These efforts were coordinated with other Charter members, to assess damage, plan rescue operations, and monitor ongoing situations using satellite imagery. Another example is the partnership between the UAE Space Agency and Planet Labs, a company that provides EO data, to develop a satellite data-driven "loss and damage atlas" aimed at supporting global climate resilience.[47] This collaboration uses high-resolution satellite imagery and AI analytical tools to quantify damages caused by extreme weather events, such as floods and droughts, and to help establish early warning systems and resilience strategies in developing countries.

The UAE further advances disaster response through AI-driven innovations, notably at the Mohamed bin Zayed University of Artificial Intelligence (MBZUAI). MBZUAI has developed an AI-based prototype for flood assessment, analyzing satellite data to evaluate the impact of the April 16, 2024, Gulf floods in the UAE and Oman.[48] This prototype uses AI and computer vision to analyze pre- and post-storm satellite imagery to identify affected infrastructure, like schools, pharmacies, and malls, offering tools for local authorities in rescue and recovery efforts. These initiatives demonstrate the UAE's integration of technologies, such as EO and AI, to strengthen disaster management, offering scalable solutions that support both national resilience and international humanitarian efforts.

Digital Dependencies and Disparities

Despite the promise of technology in disaster response, several critical challenges continue to hinder its effective application. First, the digital divide is a predominant concern, especially in developing countries. Limited access to robust ICT infrastructure and advanced technological tools means that communities most vulnerable to disasters are often those least equipped to benefit from early warning systems, satellite imagery, and AI-driven analytics. This disparity exacerbates existing inequalities and hinders the timely deployment of disaster response mechanisms.

Additionally, issues surrounding data quality and interoperability present significant obstacles. The reliability and consistency of data are crucial for accurate forecasting and real-time decision-making. However, disparate data sources and a lack of standardized protocols across various technological platforms can lead to fragmented information flows, reducing the overall effectiveness of integrated disaster management systems.

Economic challenges further compound these issues. The high costs associated with installing and maintaining resilient telecommunications networks, backup power systems, and other critical infrastructures create a financial burden, particularly for resource-constrained regions. This economic barrier limits the scalability and sustainability of advanced technological solutions in the areas that need them most. Furthermore, the impact of governance and regulatory shortcomings represent another challenge. In many instances, policy fragmentation and a lack of coordinated regulatory frameworks impede the adoption and effective integration of innovative disaster response technologies. Without cohesive policy support and strategic investment, even the most promising technological advancements may fail to achieve their full potential.

Lastly, ethical concerns regarding data privacy and algorithmic bias are also discussed. As disaster management increasingly relies on AI and machine learning, ensuring that these systems operate without reinforcing existing social inequities or infringing on individual privacy rights becomes critical. The need for comprehensive ethical guidelines and inclusive policies is imperative to balance technological innovation with the protection of vulnerable populations.

Together, these challenges underscore the complexity of integrating technology into disaster management and highlight the need for inclusive and sustainable solutions. Addressing these gaps will require continued investment, policy alignment, and capacity building across all levels of society.

Conclusion and Recommendations

Technology has become an indispensable component of disaster response, particularly as climate change exacerbates the frequency and intensity of natural disasters, with developing countries bearing the brunt of these impacts. This paper highlights the transformative potential of leveraging technological advancements, such as telecommunication infrastructure, early warning systems, satellite imagery, GIS, and artificial intelligence, to enhance disaster preparedness, response, and recovery. These tools enable rapid assessments, real-time monitoring, and informed decision-making, which are vital for saving lives and minimizing the socioeconomic impacts of disasters, particularly in developing countries that are disproportionately affected.

ICT companies have emerged as pivotal actors in disaster management, contributing resources, expertise, and innovative technologies. Their active involvement through partnerships with governments, NGOs, and humanitarian organizations demonstrates the value of public-private collaboration in addressing the growing challenges of climate change-induced disasters. Case studies, such as Cyclone Hidaya in Kenya and Storm Daniel in Libya, illustrate how the integration of advanced technologies like AI, satellite imagery, and resilient telecommunications infrastructure can significantly enhance disaster response efforts. These examples also emphasize the importance of adaptability, local capacity building, and the ethical application of technology.

However, this insight also acknowledges persistent systemic challenges, including the digital divide, infrastructure vulnerabilities, policy fragmentation, and ethical concerns surrounding AI and data governance, that prevent equitable and effective implementation. Addressing these challenges will be critical to ensuring that technology serves as a tool for resilience rather than a source of new disparities and dependency.

The UAE emerges as a notable example of how state-led innovation can support both national and international disaster response. Through its investments in EO, AI-driven analytics, and multilateral cooperation (e.g., International Charter, Planet Labs), the UAE is helping to reshape the architecture of technological humanitarianism. Its ability to deploy advanced satellite and AI tools for disaster mapping, impact assessment, and early warning—while also sharing resources with disaster-prone countries—positions it as a valuable contributor to global climate resilience efforts.

In conclusion, technological humanitarianism represents a powerful approach to mitigating the impacts of climate change and strengthening resilience in vulnerable communities. By fostering partnerships and advancing the integration of technology into disaster management frameworks, the global community can build a more sustainable and equitable response to the challenges posed by an increasingly volatile climate.

References

1. Battikh JY, Wood MO, Kitchen V, Feltmate B. Big tech and natural hazards: disaster response patterns of Fortune Global 500 ICT MNCs in developing countries. Society and Business Review. Published online May 13, 2025. doi:10.1108/SBR-05-2024-0171

2. World Meteorological Organization. State of the Global Climate 2021 : WMO Provisional Report. WMO; 2021. https://library.wmo.int/records/item/56300-state-of-the-global-climate-2021

3. IPCC. Climate Change 2023: Synthesis Report. IPCC; 2023:184. Accessed October 7, 2023. doi.org/doi:10.59327/IPCC/AR6-9789291691647

4. UNDRR. The Human Cost of Disasters: An Overview of the Last 20 Years (2000-2019).; 2020. Accessed October 21, 2020.https://www.undrr.org/publication/human-cost-disasters-overview-last-20-years-2000-2019

5. Battikh JY. How Can Fragile and Conflict-Affected Countries Benefit from COP28 Declarations? Anwar Gargash Diplomatic Academy; 2024:17. Accessed November 6, 2024. https://www.agda.ac.ae/research/publications-multimedia-events/publication-details/how-can-fragile-and-conflict--affected-countries-benefit-from-cop28-declarations

6. Zorn M. Natural Disasters and Less Developed Countries. In: Pelc S, Koderman M, eds. Nature, Tourism and Ethnicity as Drivers of (De)Marginalization: Insights to Marginality from Perspective of Sustainability and Development. Perspectives on Geographical Marginality. Springer International Publishing; 2018:59-78. doi:10.1007/978-3-319-59002-8_4

7. Battikh JY, Bodolica V, Wood MO. Disasters triggered by natural hazards and terrorism: A bibliometric network analysis into the intellectual structure of a cross-disciplinary research field. International Journal of Disaster Risk Reduction. 2022;77:103045. doi:10.1016/j.ijdrr.2022.103045

8. Oh CH, Reuveny R. Climatic natural disasters, political risk, and international trade. Global Environmental Change. 2010;20(2):243-254. doi:10.1016/j.gloenvcha.2009.11.005

9. Gallarno G, Muniz J, Parnell GS, Pohl EA, Wu J. Development and assessment of a resilient telecoms system. Journal of Defense Modeling & Simulation. 2024;21(4):405-420. doi:10.1177/15485129221143791

10. Gomes T, Tapolcai J, Esposito C, et al. A survey of strategies for communication networks to protect against large-scale natural disasters. 2016 8th International Workshop on Resilient Networks Design and Modeling (RNDM). Published online September 2016:11-22. doi:10.1109/RNDM.2016.7608263

11. Patricelli F, Beakley JE, Carnevale A, Tarabochia M, Von Lubitz DKJE. Disaster management and mitigation: the telecommunications infrastructure. Disasters. 2009;33(1):23-37. doi:10.1111/j.1467-7717.2008.01060.x

12. Karaman B, Basturk I, Taskin S, et al. Solutions for Sustainable and Resilient Communication Infrastructure in Disaster Relief and Management Scenarios. Published online 2024. doi:10.48550/ARXIV.2410.13977

13. O'Reilly G, Jrad A, Nagarajan R, Brown T, Conrad S. Critical Infrastructure Analysis of Telecom for Natural Disasters. Ieee; 2006. 10.1109/NETWKS.2006.300396

14. Kwasinski A. Technology Planning for Electric Power Supply in Critical Events Considering a Bulk Grid, Backup Power Plants, and Micro-Grids. JSYST. 2010;4(2):167-178. doi:10.1109/JSYST.2010.2047034

15. Comfort LK, Haase TW. Communication, Coherence, and Collective Action: The Impact of Hurricane Katrina on Communications Infrastructure. Public Works Management & Policy. 2006;10(4):328-343. doi:10.1177/1087724X06289052

16. Ericsson. Ericsson Response and humanitarian emergency relief. ericsson.com. 2025. Accessed February 16, 2025. https://www.ericsson.com/en/about-us/sustainability-and-corporate-responsibility/digital-inclusion/humanitarian-response

17. WFP. UN World Food Programme (WFP). 2025. Accessed February 16, 2025. https://www.wfp.org/

18. ETC. Emergency Telecommunications Cluster (ETC). 2025. Accessed February 16, 2025. https://www.etcluster.org/

19. Bennett D. Information and Communication Technology in Crisis and Disaster Management. Published online October 30, 2019. doi:10.1093/acrefore/9780190228637.013.1582

20. Kedia T, Ratcliff J, O'Connor M, et al. Technologies Enabling Situational Awareness During Disaster Response: A Systematic Review. Disaster med public health prep. 2022;16(1):341-359. doi:10.1017/dmp.2020.196

21. Buzzelli MM, Morgan, Ba P, Muschek, Ba AG, Macgregor-Skinner, BVSc, MSc, Mph, Mrcvs G. Information and communication technology: Connecting the public and first responders during disasters. JEM. 2014;12(6):441-447. doi:10.5055/jem.2014.0207

22. Ocen GG, Mugeni G, Matovu D. Role of ICT in Disaster Response and Management. In: ; 2016. Accessed January 6, 2025. https://www.semanticscholar.org/paper/Role-of-ICT-in-Disaster-Response-and-Management-Ocen-Mugeni/38f71c9878329a95a60603ea3e81aaa8e025ae11

23. Scott N, Batchelor S. Real Time Monitoring in Disasters. IDS Bulletin. 2013;44(2):122-134. doi:10.1111/1759-5436.12022

24. Li WS, Chang CL, Chen KH, Lee Y. How ICT Changes the Landscape of Disaster Risk Management. In: Murayama Y, Velev D, Zlateva P, eds. Vol 516. IFIP Advances in Information and Communication Technology. Springer International Publishing; 2019:12-18. doi:10.1007/978-3-030-18293-9_2

25. Nachappa MN, Sharma H, Pal R. An Overview of Deployment of Information and Communications Technology (ICT) in Disaster Risk Management. 2023 International Conference on Advances in Computation, Communication and Information Technology (ICAICCIT). Published online November 23, 2023:676-680. doi:10.1109/ICAICCIT60255.2023.10465756

26. Mudombi S, Muchie M. ICTs in development and disaster response: Opportunities and challenges for Africa. 2010 3rd International Symposium on Applied Sciences in Biomedical and Communication Technologies (ISABEL 2010). Published online November 2010:1-5. doi:10.1109/ISABEL.2010.5702865

27. Google. Flood Forecasting. Flood Forecasting. 2025. Accessed February 17, 2025. https://sites.research.google/gr/floodforecasting/

28. Nearing G, Cohen D, Dube V, et al. Global prediction of extreme floods in ungauged watersheds. Nature. 2024;627(8004):559-563.doi:10.1038/s41586-024-07145-1

29. Google. Support for those affected by Kenya's flood crisis. Google. May 9, 2024. Accessed February 17, 2025. https://blog.google/intl/en-africa/company-news/support-for-those-affected-by-kenyas-flood-crisis/

30. Google. Flood Hub. 2025. Accessed December 26, 2024. https://sites.research.google/floods/l/0/0/3

31. Robinson C, Gupta R, Nsutezo SF, et al. Turkey Building Damage Assessment.; 2023. https://www.microsoft.com/en-us/research/wp-content/uploads/2023/02/Turkey-Earthquake-Report-2_MS.pdf

32. Esri. Esri Disaster Response Program | Maps, Software & Support with GIS Technology. 2024. Accessed December 28, 2024. https://www.esri.com/en-us/disaster-response/overview

33. International Center for Humanitarian Affairs. Leveraging Technology in the Face of Disaster - Kenya.; 2024:11. Accessed September 22, 2024. https://icha.net/wp-content/uploads/2024/08/Leveraging-Technology-in-the-Face-of-Disaster.pdf

34. Hsu A. How Artificial Intelligence Can Accelerate Global Climate Action. Anwar Gargash Diplomatic Academy; 2024. Accessed February 17, 2025. https://www.agda.ac.ae/research/publications-multimedia-events/publication-details/how-artificial-intelligence-can-accelerate-global-climate-action

35. Microsoft. AI For Good Lab. Microsoft Research. 2025. Accessed February 17, 2025. https://www.microsoft.com/en-us/research/group/ai-for-good-research-lab/

36. Microsoft. This non-profit is protecting vulnerable communities from the effects of climate change with AI. Source Asia. October 20, 2021. Accessed February 17, 2025. https://news.microsoft.com/source/asia/features/seeds-india-climate-change-ai/

37. Sohail S. A.I Enabled Disaster Response. ArcGIS Blog. November 14, 2019. Accessed January 9, 2025. https://www.esri.com/arcgis-blog/products/arcgis-enterprise/public-safety/a-i-enabled-disaster-response

38. Bromley L, Jauer K, Matias Y. AI from Google Research and UN boosts humanitarian disaster response: Wider coverage, faster damage assessments. Disha. September 16, 2024. Accessed January 9, 2025. https://disha.unglobalpulse.org/ai-from-google-research-and-un-boosts-humanitarian-disaster-response-wider-coverage-faster-damage-assessments/

39. Normand JCL, Heggy E. Assessing flash flood erosion following storm Daniel in Libya. Nat Commun. 2024;15(1):6493. doi:10.1038/s41467-024-49699-8

40. OCHA. Libya: Flood Response Humanitarian Update (as of 20 March 2024) [EN/AR] | OCHA.; 2024. Accessed January 9, 2025. https://www.unocha.org/publications/report/libya/libya-flood-response-humanitarian-update-20-march-2024-enar

41. McKnight B, Linnenluecke MK. How Firm Responses to Natural Disasters Strengthen Community Resilience: A Stakeholder-Based Perspective. Organization & Environment. 2016;29(3):290-307. doi:10.1177/1086026616629794

42. Johnson BR, Connolly E, Carter TS. Corporate social responsibility: the role of Fortune 100 companies in domestic and international natural disasters. Corporate Social Responsibility and Environmental Management. 2011;18(6):352-369. doi:10.1002/csr.253

43. Auzzir ZA, Haigh RP, Amaratunga D. Public-private Partnerships (PPP) in Disaster Management in Developing Countries: A Conceptual Framework. Procedia Economics and Finance. 2014;18:807-814. doi:10.1016/S2212-5671(14)01006-5

44. Alony I, Haski-Leventhal D, Mehra A. Motivations, activities, timing, and employee engagement: three approaches to business involvement in disasters. Disasters. 2024;48(3):n/a-n/a. doi:10.1111/disa.12617

45. Ballesteros L, Useem M, Wry T. Masters of Disasters? An Empirical Analysis of How Societies Benefit from Corporate Disaster Aid. AMJ. 2017;60(5):1682-1708. doi:10.5465/amj.2015.0765

46. UAE Space Agency. UAE Space Agency Supports International Relief Efforts in Morocco. UAE Space Agency. February 26, 2024. Accessed May 28, 2025. https://space.gov.ae/en/media-center/news/15/9/2023/uae-space-agency-supports-international-relief-efforts-in-morocco

47. UAE Space Agency. The UAE Space Agency Partners with Planet Labs to Build Satellite Data-driven Loss and Damage Atlas for Global Climate Resilience. UAE Space Agency. February 26, 2024. Accessed May 28, 2025. https://space.gov.ae/en/media-center/news/26/5/2023/the-uae-space-agency-partners-with-planet-labs-to-build-satellite-data-driven-loss-and-damage-atlas

48. MBZUAI. MBZUAI looks to AI-powered solutions for extreme weather events following recent flooding in Gulf region. MBZUAI. May 13, 2024. Accessed May 28, 2025. https://mbzuai.ac.ae/news/mbzuai-looks-to-ai-powered-solutions-for-extreme-weather-events-following-recent-flooding-in-gulf-region/

أكاديمية
أنور قرقاش
الدبلوماسية

ANWAR GARGASH
DIPLOMATIC
ACADEMY

مركز
الدبلوماسية
المناخية

Centre
for Climate
Diplomacy

In Collaboration with

MUBADALA

أدنوك
ADNOC

Email: CCD@agda.ac.ae

www.agda.ac.ae

@agdauae

Anwar Gargash Diplomatic Academy